DAY DETECTION FORMULA

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Let the given date be D-M-Y"Y

Notations are given below:-

D is date in month M of that year Y"Y in a century where Y" is fixed number for the century as 20 in 2001 and Y unfixed number for the century as 01 in 2001 & M' is month of 30 days before the month M in the year Y"Y. Also, YL is leap year just before Y"Y. In calculation, remainder Rem gives numbers N' & W'.

Note:-

1)Monday was on 1-1-2001.

Pattern:-Days decrease by 1 day on same date & month of next century only in Julian calendar up to 1-1-1701 as from then Gregorian calendar was introduced. (Ex- Saturday was on 1-1-0001 & Friday on 1-1-0101)

2)Days may differ from your calculations in dates falling in the range of 04-10-1582 to dd-mm-1923(or whole 20th century for some countries) but don't worry as it will be still correct. This is because of transition of Julian calendar to Gregorian calendar and in this transition, some countries accepted Gregorian calendar earlier and some countries accepted it later.

3)Gregorian calendar was introduced in October 1582 by Pope Gregory XIII.

4)Days increase by 1 day on each year on the same date and month but increase by 2 after 29th February of a leap year.

5)days in every centuries's 1st dates of Gregorian calendar is decreased by 1 day to reform the calculation except for those after which are divisible by 400.

(Ex- Centuries like 2101, 2201 & 2301 comes after 2100, 2200 & 2300, respectively. Hence their 1st Jan day will be decreased by 1 day.

Like, on 31-12-2100 is Saturday but we will have 1-1-2101 to be also a Saturday not Sunday. But since 2400 is divisible by 400, we will count the coming day normally on 1-1-2401. Meaning, on 31-12-2400 is a Sunday and 1-1-2401 is Monday.)

Detection:-

(note:-we will later know how to detect century's 1st date's day) For Now, we have century's 1st date's day known then

D-M-Y"Y will be:

Step 1:- Y+(YL/4)=N (a number)

Step 2:- Rem(N/7)=N'.

Now, count days up to N' from the day on 1-1-Y"01(known). Let that day be X.

➢X is on 1-1-Y"Y.

Step 3:- D+(M-1)31-M'-[3 or 2 or 0 according to Y being non-leap year or leap year or M is Jan/Feb, respectively]=W (a number)

Step 4:- Rem(W/7)=W'.

Now, count days up to W' from X. Let that day be Z.

➢ Z is on D-M-Y"Y.

Example:-

Day on 17 Oct 2015? Given Mon on

1-1-2001.

Detection: 17-10-2015

Step 1:- 15+(12/4)=18

Step 2:- Rem(18/7)=4[Thursday] (by counting from Mon on 1-1-2001)

:1-1-2015 is Thursday.

Step 3:-9×31+17-3-3=290.

Step 4:-Rem(290/7)=3[Saturday] (by counting from above day)

:17-10-2015 is Saturday.

But this 4 step formula takes so long. There is a one-step formula which is a combination of all the 4 steps.

One step formula:- given century's date:-

We know that whenever original numerator is greater than denominator, the remainder of an original numerator divisible by denominator is equal to the addition of remainders obtained by splitting original numerator divisible by same denominator whenever at least one splitting numerator is equal to or greater than denominator. But when original numerator is less than denominator, the remainder of an original numerator divisible by denominator is equal to the addition of remainders obtained by splitting original numerator divisible by same denominator.

i.e. Rem(N/D)=rem(n/D)+rem(m/D), where N < D and N=n+m, then n+m<D

And when N>D and N=n+m+o+p....., then at least one out of n,m,o,p.....>D.

Note:- in this combined formula , we will subtract 1[or rem(8/7)] in it so as to get right day. It is so because when we count days separately in 4 step formula, it has a day in step 2 counted again in step 3.

Combined Formula for Day detection:-

➢(Rem{[D+(M-1)x31+Y+(YL/4)-M'-(3 if Y a non-leap year, 2 if Y a leap year & 0 if M is Jan/Feb)]/7})-1[or rem(8/7)]=Z(a number).

:Now, we know that (-1) can be introduced into numerator as it will effect the remainder but not the final answer.

On further on introducing (-1) in numerator, we get

➢Rem{[D+(M-1)x31+Y+(YL/4)-M'-(4 if Y a non-leap year, 3 if Y a leap year & 1 if M is Jan/Feb)]/7}=Z(a number).

Now, count days from day on 1-1-Y"01 up to Z.[For ex, if Z is 2 from 20th century then we know 1-1-1901 was Tuesday (1), then Z is Wednesday(2)]

Note: This is the formula used when century's 1st date's day is known and it will be applied to only dates falling in this century.

Example:-Day on 10th March 1996? Given 1-1-1901=Tuesday.

Detection:- We know 1-1-1901=Tuesday.

Now, 10-03-1996?

Applying formula, we get

Rem{[10+(3-1)×31+96+(92/4)-0-3]/7}

=Rem{[10+62+96+23-3]/7}=Rem(188/7)

=Rem{(7×26/7)+6/7}=6

Count from Tuesday on 1-1-1996 upto 6 we get Sunday.

Therefore, 10-03-1996=Sunday.

Formula for detecting day on 1st date of any century, i.e. on 1-1-Y"01:-

See the following two calendars. Here, days are mentioned against century's 1st date.

Based on Calendar for India. Date is based on the old Julian Calendar calendar which was in use before.

0001>sat 0101>fri 0201>Thurs 0301>wed 0401>tue 0501>mon 0601>sun 0701>sat 0801>fri

0901>thurs 1001>wed 1101>tue 1201>mon 1301>sun 1401>sat 1501>fri 1601>thurs 1701>wed

Based on Calendar for India. Date is based on the modern Gregorian Calendar.

1801>Thurs 1901>Tue 2001>Mon 2101>sat 2201>Thurs 2301>Tue 2401>Mon 2501>sat 2601>Thurs 2701>Tue 2801>Mon 2901>sat 3001>Thurs 3101>Tue 3201>Mon 3301>sat 3401>Thurs 3501>Tue 3601>Mon 3701>sat 3801>Thurs 3901>Tue 4001>Mon.....

Reverse order formula:-

Consider C, B & A be some elements in a series, C is at position 1, B at 2 & A at 3 after being reversed. Also, we can say, C is at 1(=3+1-3), B is at 2(=3+1-2) and A is at 3(=3+1-1). Further, we can say, in reverse order, C being at position 1(=number of elements in a series+1-C's earlier position) and we can say same with the B & C. Therefore, we get a general formula from this example of this series that

P=N+1-n, where P is the position of element in reverse order, N is the total number of elements

in the series and n was the position of element in non-reversed order.

1)For Julian calendar:-

We see that 1-1-0001 was Sat

1-1-0101 was Fri

1-1-0201 was Thurs and so on.... until 1-1-1701 was Wed.

This shows reverse order of days on centuries's 1st dates. Now, there are 7 days and we are reversing them as pattern in Julian calendar and taking sat to be the first day as sat was on 1-1-0001(start of Julian calendar), we get the table for Julian calendar as

Sat(0), Fri(1=8-7), Thurs(2), Wed(3), Tue(4), Mon(5) Sun(6) and Sat(7=8-1)

Memorize this table for best.

By table:-

Now in any 1-1-Y"01 of Julian calendar, we have rem(Y"/7)=Q. Now match the number Q

from the above memorized table, that is the day on 1-1-Y"01.

If you don't want to memorize the above table, then by reverse order formula, we can find days on every 1-1-Y"01 falling in Julian calendar.

By reverse order formula:-

According to the reverse order formula,

We have 8- rem(Y"/7)=P. Now count from Sat(1) in normal days order up to P and getting day Z, then Z is on 1-1-Y"01.

Example:-Day on 1-1-1601?

Detection:-

1)By table:

Rem(Y"/7)= rem(16/7)= 2. Now, from table, we get, on 1-1-1601 was Thursday.

2)By reverse order formula(when you don't memorize table):

8-rem(Y"/7)=8-rem(16/7)=8-2=6. Now, counting from sat up to 6(i.e. Sat, Sun.....Thurs), we get Thursday was on 1-1-1601.

2)For Gregorian calendar:-

We see that 1-1-1801 was Thurs

1-1-1901 was Tues

1-1-2001 was Mon

1-1-2101 will be Sat

1-1-2201 will be Thurs

And so on.....

This shows reverse order of only 4 days on centuries' 1st dates. Now, there are 4 days and we are reversing them as pattern in Gregorian calendar, we get the table for Gregorian calendar as

Mon(0), Sat(1=5-4), Thurs(2), Tues(3) & Mon(4=5-1)

Memorize this table for best.

Note:- Here we took Mon to be the first day as Mon was on 1-1-2001(Third Century after the start of Gregorian calendar, i.e. 1-1-1801). This is so because Y"=20 is fully divisible by 4 as was in Julian calendar, we had Y"=00 & Y"=07 were fully divisible by 7 and those dates' days were Sat.

By table:-

Now in any 1-1-Y"01 of Gregorian calendar, we have rem(Y"/4)=Q. Now match the number Q from the above memorized table, that is the day on 1-1-Y"01.

If you don't want to memorize the above table, then by reverse order formula, we can find days on every 1-1-Y"01 falling in Gregorian calendar.

By reverse order formula:-

According to the reverse order formula,

We have 5- rem(Y"/4)=P. Now count from Mon(1) in only 4 days order up to P(i.e. among

Mon, Tues, Thurs & Sat) and getting day Z, then Z is on 1-1-Y"01.

Example:-Day on 1-1-2201?

Detection:-

1)By table:

Rem(Y"/4)= rem(22/4)= 2. Now, from table, we get, on 1-1-2201 was Thursday.

2)By reverse order formula(when you don't memorize table):

5-rem(Y"/4)=5-rem(22/4)=5-2=3. Now, counting from Mon up to 3(i.e. Mon, Tues & Thurs), we get Thursday was on 1-1-2201.

General formula for any dates falling in Julian calendar:-

We know that Rem(N/D)=rem(n/D)+rem(m/D),

where N < D and N=n+m, then n+m<D

And when N>D and N=n+m+o+p....., then at least one out of n,m,o,p.....>D.

But in combining two formulae, i.e.

Formula for detecting day on 1st date of any century in Julian calendar+Combined Formula for Day detection, one day is counted twice. So, we will subtract 1[or rem(8/7)] in numerator for this resolution.

So, on combination, we get

Julian formula(we will call it so):-

Rem{[D+(M-1)×31+Y+(YL/4)-M'-(4 iff Y=Non leap year, 3 iff Y=Leap year & 1 iff M=Jan/Feb)+8-rem(Y"/7)-1(or rem(8/7))]/7}=Z.

On solving, we get

Rem{[D+(M-1)×31+Y+(YL/4)-M'+(3 iff Y=Non leap year, 4 iff Y=Leap year & 6 iff M=Jan/Feb)-rem(Y"/7)]/7}=Z.

Also, rem{[N-rem(Y"/7)]/7}=rem{(N-Y")/7}
Where N is any natural number.

Rem{[D+(M-1)×31+Y+(YL/4)-Y"-M'+(3 iff Y=Non leap year, 4 iff Y=Leap year & 6 iff M=Jan/Feb)]/7}=Z.

Now, count days from Sat up to Z and getting day B. Therefore, B is on D-M-Y"Y.

(Sat is taken as start because as for formula for centuries' 1st dates in Julian calendar, we took Sat as a start as in 1-1-0001 and 1-1-0701, 00 and 07 are divisible by 7 and on that day it was Sat)

Note: 1)subtract scaler number which comes in numerator from 7 when comes -ve as it will not effect the remainder because days are also 7 and it will become positive.

2)If Z is still a big number, then do rem(Z/7).

Example:- Day on 10-03-1396?

Detection:- we have 10-03-1396.

Now, rem{[10+(3-1)×31+96-13+(92/4)-0+4]/7}

=rem[(10+62+96-13+23+4)/7]

=rem(182/7)=0.

Fri is on 10-03-1396 by going back from Sat up to 0 as Sat being 1.

General formula for any dates falling in Gregorian calendar:-

We know that Rem(N/D)=rem(n/D)+rem(m/D),

where N < D and N=n+m, then n+m<D

And when N>D and N=n+m+o+p....., then at least one out of n,m,o,p.....>D.

But in combining two formulae, i.e.

Formula for detecting day on 1st date of any century in Gregorian calendar+Combined Formula for Day detection, one day is counted twice. So, we will subtract 1[or rem(8/7)] in numerator for this resolution.

Gregorian formula(we will call it so):-

5-rem(Y"/4)+Rem{[D+(M-1)×31+Y+(YL/4)-M'-(4 iff Y=Non leap year, 3 iff Y=Leap year & 1 iff M=Jan/Feb)-1(or rem(8/7))+3(or rem(10/7))]/7}=Z.

On solving, we get

∴ -rem(Y"/4)+Rem{[D+(M-1)×31+Y+(YL/4)-M'+(3 iff Y=Non leap year, 4 iff Y=Leap year & 6 iff M=Jan/Feb)]/7}=Z.

Now, count days from Mon up to Z and getting day B. Therefore, B is on D-M-Y"Y. (Mon is taken as start because as for formula for centuries' 1st dates in Gregorian calendar, we took Monday as a start as in 1-1-2001, 20 is divisible by 4 and on that day it was Monday)

Note: 1)subtract scaler number which comes in numerator from 7 when comes -ve as it will not effect the remainder because days are also 7 and it will become positive.

2)If Z is still a big number, then do rem(Z/7).

Example:- Day on 1-1-40001?

Detection:- We have 1-1-40001.

Now, rem(400/4)= 0.

From the table of Gregorian calendar, we have it to be Mon.

Example:- Day on 2-11-40005?

Detection:-We have 2-11-40005.

-rem(400/4)+Rem{[2+(11-1)×31+05+(4/4)-3+3]/7}

=-0+Rem{[2+310+05+1]/7}

=rem(318/7) =rem(315+3/7)=3.

Wednesday(counting from Mon as we took Mon as 1 in Gregorian calendar)

Most simple is to go through date by date with confirmed numbers:-

Step 1:- 8-rem(Y"/7) or 5-rem(Y"/4).

Step 2:- rem[(Y+YL)/7].

Step 3:- if Y"Y=LY, then

Jan(1) Feb(4) Mar(5) Apr(1) May(3) Jun(6) Jul(1) Aug(4) Sept(0) Oct(2) Nov(5) Dec(0)

If Y"Y=NLY, then

Jan(1) Feb(4) Mar(4) Apr(0) May(2) Jun(5) Jul(0) Aug(3) Sept(6) Oct(1) Nov(4) Dec(6)

Step 4:- dates 1,8,15,22,29 in same month have same days. Use them to go near by dates.